

**UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF TEXAS
HOUSTON DIVISION**

NEXUS PERFORATING LLC,)	
)	
Plaintiff,)	
)	
v.)	
)	Civil Case No. 4:20-cv-1539
C&J ENERGY SERVICES, INC., a)	
Delaware Corporation; NEXTIER)	
OILFIELD SOLUTIONS, INC., a)	JURY TRIAL DEMANDED
Delaware Corporation; and, STEVE)	
DELOZIER, an individual)	
)	
Defendants.)	

SECOND AMENDED COMPLAINT

PLAINTIFF Nexus Perforating LLC (“PLAINTIFF” or NEXUS”) for its Second Amended Complaint against Defendants, states and alleges the following:

I. PARTIES

1. PLAINTIFF is a limited liability company organized under the laws of the State of Texas, having its principal place of business at 3311 Normandy Forest Ct., Spring, Texas 77388. PLAINTIFF is the owner of record for U.S. Pat. No. 10,352,136 (“the ‘136 patent”). Reel/frame: 051794/0400.

2. Upon information and belief, Defendant C&J Energy Services, Inc. (“C&J”) is and/or was a corporation organized under the laws of the State of Delaware, having a principle address and doing business at 3990 Rogerdale Road, Houston, Texas 77042. C&J’s registered agent for service of process is CSC-Lawyers Incorporating, having an

address at 211 E. 7th Street, Suite 620, Austin, Texas 78701-3218. C&J was served.

3. Upon information and belief, Defendant NexTier Oilfield Solutions, Inc. (“NEXTIER”) is a corporation organized under the laws of the State of Delaware, having a principle place of business at 3990 Rogerdale Road, Houston, Texas 77042. NEXTIER’S registered agent for service of process is the Corporation Trust Company, Corporation Trust Center 1999 Bryan St., Ste. 900, Dallas, TX 75201-3136, and it has been served.

4. Upon information and belief, Steve DELOZIER (“DELOZIER”) is an individual living in the State of Texas, and doing business in Houston at 3990 Rogerdale Road, Houston, Texas 77042. Service of process is proper and was made on this individual.

II. JURISDICTION AND VENUE

5. This is an action for patent infringement arising under the patent laws of the United States, Title 35 United States Code, 35 U.S.C. §1, *et seq.* This Court has subject matter jurisdiction for the claims of patent infringement under 28 U.S.C. §§1331 and 1338. The action asserts state causes of action for common law fraud, breach of implied contract, and negligent misrepresentation. Venue is proper for any state claims based on the Court’s power of supplemental jurisdiction.

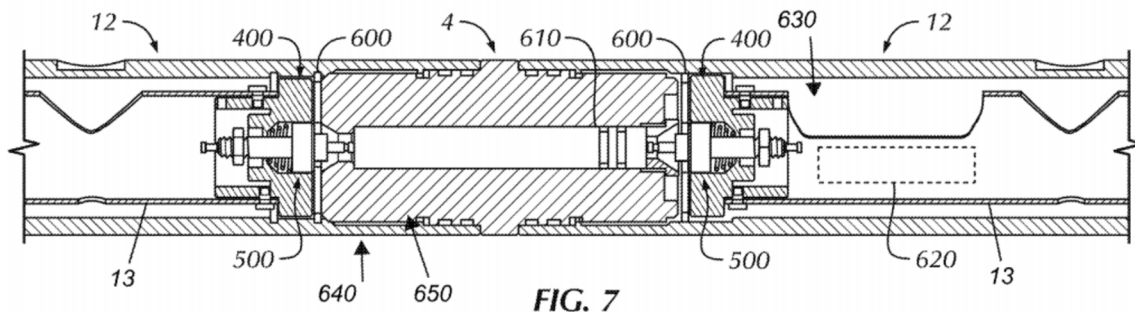
6. Defendants are subject to the jurisdiction of this Court by reason of their acts of patent infringement, and other tortious conduct, which have been committed in this Judicial District, and by virtue of its regularly conducted and systematic business contacts in this state. Further, Defendants have a principal place of business at 3990 Rogerdale Road, Houston, Texas 77042. DELOZIER is subject to the jurisdiction of this Court and he has been served.

7. Venue is proper in this Judicial District under 28 U.S.C. §§ 1391(b)-(c) and 1400(b).

III. FACTS

8. U.S. Pat. 10,352,136 (“the ‘136 patent”) (attached herein as Exhibit A) issued to inventor Sergio F. Goyenneche (hereinafter “Sergio”) on Jul. 16, 2019. The ‘136 patent was duly assigned to Nexus and the assignment was recorded with the U.S. Patent and Trademark Assignment Database at Reel/Frame: 051794/0400. Accordingly, Nexus is the owner of record and exclusive rights holder of the ‘136 patent.

9. The ‘136 patent relates to an innovative way of wirelessly connecting perforating guns (“perf guns”) into a long assembly, known as a string, that is then lowered down an oil-well and used to shoot a pattern of holes into the well casing so that oil can spill into the casing and then be harvested at the surface. *See* Ex. A, pg. 2 (Abstract). An example of two connected guns (identified as element 12) according to the ‘136 patent is provided below:

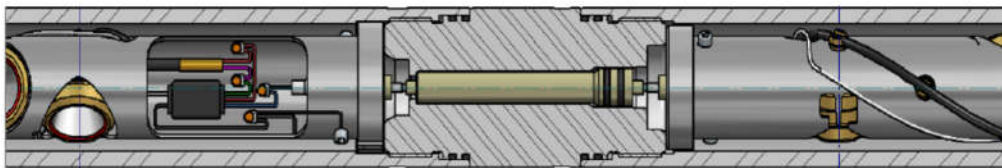


See Ex. A, pg. 9.

10. Perf guns are assembled or connected into a string on-site. In one mode of

operation, a connected perf gun string delivers shaped charges¹ in firing-order down a well casing. *See* Ex. A. Before the ‘136 patented technology, guns were electrically connected with wires and this type of connection was often undesirable since the firing of an adjacent gun in the string would sometimes damage the wiring and cause a mid-string cease-fire. *Id.*, at pg. 10 (Col. 2:4-16). The ‘136 patent (as exemplified by the preferred embodiment above) improved the state of the art when it described a more reliable electromechanical connection of two perf guns without wires in a way that protected the connection from being damaged by proximately detonated charges. *See Id.* at pg. 2 (Abstract).

11. The patent application underlying the ‘136 patent was filed on May 15, 2015 with a request for treatment under the International Phase of the Patent Cooperation Treaty (PCT) (Application Number PCT/US2015/031047). A related U.S. Patent Application (Ser. No. 15/312,120) was timely filed on Nov. 17, 2016. The ‘136 patent issued Jul. 16, 2019 with claims 1 through 20. *See* Ex. A. While the PCT patent was pending, Sergio, on behalf of NEXUS, developed a line of the patent pending perforating guns and/or parts that could be assembled on-site into the gun assembly. NEXUS then began selling the perf guns or parts featuring the patent pending technology. An example of an electromechanical connection between two perf guns, as designed by Nexus, is illustrated below:



¹ A “shape charge” is an explosive inside a cavity where the explosive upon detonation produces a detonation wave front determined by the shape of the cavity.

12. C&J was a perf gun manufacturer. On or about March 30-31, 2016, NEXUS communicated with DELOZIER, a technology manager at C&J, to discuss the “patent pending” technology and the feasibility of implementing into C&J’s products the electromechanical connection designed by Nexus. At C&J, from about September 2012 to 2017, DELOZIER held titles such as “Senior Director, Perforating Technologies and Compliance” and “Director of Perforating Technology” where his responsibilities included “lead buyer & liaison for 3rd party perforating purchases.” On information and belief, at all relevant times, DELOZIER was acting in the course of scope of his position as an employee with C&J, so that his actions are those of C&J under the doctrine of *respondeat superior*. In about March 2017, DELOZIER contacted NEXUS and expressed significant interest and sought more information from Sergio about the NEXUS technology and its electromechanical gun connection designs. DELOZIER sought an in-person meeting with Sergio to see samples of NEXUS’ perf guns and this happened in late March 2017.

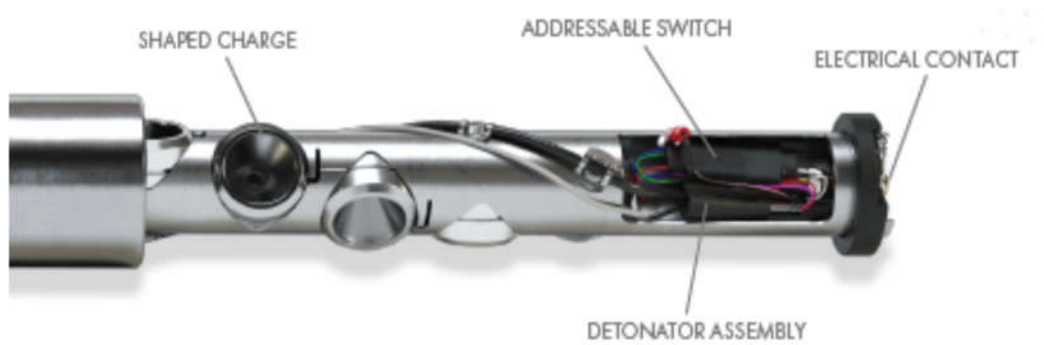
13. Sergio, on behalf of NEXUS, again met with DELOZIER on Mar. 31, 2017 to review parts that NEXUS developed for C&J guns. During and after the meeting, further modifications of NEXUS parts for C&J guns were made and different sized parts were developed. NEXUS continued development of perforating guns and/or parts that could specifically be used in C&J’s existing gun plans to accomplish an electromechanical connection like NEXUS used in its perf guns. C&J worked with NEXUS and made modifications to the parts to retrofit to C&J’s existing gun plans. Parts were developed based on extensive contractual communications between C&J and NEXUS about uses and sales from NEXUS to C&J. C&J purchased small orders of parts, but with the agreement

that larger orders would be forthcoming of the NEXUS parts. NEXUS developed the parts for C&J's perf guns in exchange for representations that it would be the exclusive provider of those parts for C&J when and as it expanded production.

14. C&J's guns using NEXUS' parts were successfully tested in Denver, Colorado around October 9, 2017. Consistent with prior representations, DELOZIER told NEXUS of forthcoming part orders to retrofit 15,000 guns per month for the upcoming 2018 year. After this meeting, however, DELOZIER completely stopped communicating with NEXUS.

15. Later, NEXUS learned that C&J, without ever having delivered the promised performance, came out (circa July 2018) with an electromechanically connected perf gun assembly called the "GameChanger™ Perforating System." ("GameChanger™") ("GameChanger")(see attached Exhibit B and Exhibit C marketing materials for the GameChanger). Sergio discovered GameChanger™ because it was put on display by C&J at a Galveston Convention.

16. When Sergio learned of the GameChanger™ being shown at the convention and read the marketing materials, Sergio knew that NEXUS' designs, parts, and efforts had been misappropriated via false promises of business as compensation. Marketing materials for the GameChanger™ show the following image:



See Ex. B. With respect to the GameChanger, the same marketing materials say:

“The GameChanger perforating system features a semi-disposable gun assembly designed to increase efficiency and reliability by eliminating the misruns and resulting NPT associated with traditional gun systems. It is compatible with all manufacturers’ standard shaped charges and uses addressable switches to provide real-time confirmation throughout the downhole descent. With no wires running between guns, the system provides design improvements that deliver a high level of confidence in the wellbore.”

See Ex. C. GameChanger™ is clearly a copy of the parts and units developed by NEXUS for C&J for testing because the GameChanger™ wirelessly connects guns using NEXUS’ parts (or derivatives thereof) developed during the testing of C&J guns with NEXUS. No orders were ever made by C&J despite the agreement.

17. At various times, NEXUS reached out to C&J to address the misappropriation. However, no legitimate efforts were made to compensate NEXUS for its efforts and C&J absconded with proprietary information that was shared with them based on false promises of business as compensation. No legitimate efforts were made to compensate NEXUS for its efforts. DELOZIER called Sergio and offered a lowball “lump sum” for the infringements moving forward. On Aug. 31, 2018 C&J asked for a “paid up license” for the “patent pending” rights. NEXUS did not agree. C&J made further attempts

to obtain a license for its infringements of NEXUS' technology, but not at rates that were reasonable, or that would excuse the lack of good faith in its dealings with NEXUS, or the surreptitious use of NEXUS technology in its "GameChanger™" product.

18. On information and belief, C&J merged or reorganized with KEANE to form NEXTIER. The exact nature of the new entity or DELOZIER's role in the entity, if any, is not yet known. However, the GameChanger™ continues to be made, sold, and used by NEXTIER without a license and in violation of the '136 patent.

19. NEXTIER appears to be a successor in interest to the business of C&J so that the actions of C&J, including tortious and contractual breaches of C&J are believed to be liabilities of NEXTIER, including in each of Counts 1-9 below.

IV. COUNT 1






(Patent Infringement)


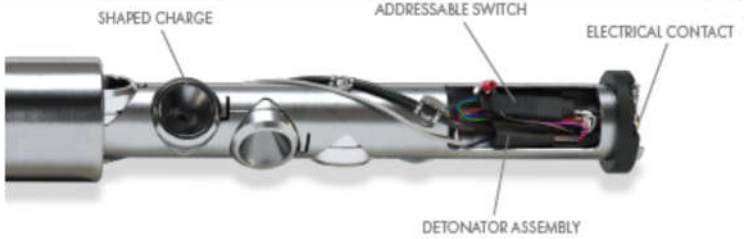
20. PLAINTIFF re-alleges the allegations contained in previous paragraphs as if fully set forth herein.

21. Upon information and belief, in violation of 35 U.S.C. § 271(a) Defendants C&J and NEXTIER directly infringed and continue to infringe the '136 Patent by making, using, selling and/or offering for sale in the United States, including within this Judicial District, products that infringe one or more of the claims of the '136 Patent, all without authority of PLAINTIFF.

22. An infringement claim chart for the independent claim of the '136 patent is appended below. The language of the claim is provided in the left column with each limitation of the claim presented in its own row. The asserted basis for infringement, row-

by-row and limitation-by-limitation, is provided in the second column on the right. The chart is provided below:

Claim 1	The GameChanger™
1. A gun assembly for perforating wells comprising:	 <p style="text-align: center;">GAMECHANGER™ PERFORATING SYSTEM</p> <p>DESCRIPTION The GameChanger perforating system features a semi-disposable gun assembly</p>
at least one gun body casing, the casing being a hollow cylinder, with a box fitting at each end;	 <p style="text-align: center;"><u>Gun body</u> <u>Box fitting</u> <u>Hollow cylinder</u></p>
a charge carrier, the carrier being a hollow cylinder, with exterior diameter less than the interior diameter of the casing, and a length shorter than the distance between the box fittings of the casing;	 <p style="text-align: center;"><u>Hollow cylinder</u></p> <p style="text-align: center;"><u>Charge carrier</u></p> <p style="text-align: right;"><u>Interior diameter less than distance between box fittings</u></p>
a plurality of shape charges positioned radially inside the charge carrier and inter connected by a detonator cord;	 <p style="text-align: center;"><u>Shape charges</u> <u>Detonator cord</u></p>
a plurality of end caps affixed to the ends of the carrier and axially aligning the carrier within the casing between the box fitting ends, and secured therein;	

<p>at least one end cap being of a durable material, electrically conductive and electrically connects the charge carrier of the gun body;</p>	
<p>an addressable detonation switch electrically connected between an inner side of at least one end cap and the plurality of shape charges within the charge carrier.</p>	

23. Several other patent claims that depend from the asserted independent claim are also infringed. These asserted claims and related infringement charts will be provided at a later date in accordance with the local patent rules.

24. PLAINTIFF has been harmed by C&J and NEXTIER'S infringing activities.

25. PLAINTIFF is entitled to an injunction and damages of not less than a reasonable royalty and/or its lost profits.

V. COUNT 2 **(Willful Infringement)**

26. PLAINTIFF re-alleges the allegations contained in previous paragraphs as if fully set forth herein.

27. Upon information and belief, C&J and NEXTIER acted with intent in their

continued infringement of PLAINTIFF's '136 Patent. Not only have C&J and NEXTIER had notice of the '136 Patent, C&J and NEXTIER, without justification, continue to flagrantly infringe the '136 Patent.

28. As such, upon information and belief, C&J and NEXTIER have willfully infringed the '136 Patent and PLAINTIFF has been harmed by C&J and NEXTIER'S activities.

VI. COUNT 3

(Common Law Fraud)

29. PLAINTIFF re-alleges the allegations contained in previous paragraphs as if fully set forth herein.

30. The elements of fraud are (1) a material false representation or omission, (2) that was made with knowledge or recklessness as to its falsity, (3) with the intent to induce reliance, and (4) that the other party "actually and justifiably relied upon," causing him injury.

31. DELOZIER and C&J made materially false representations and omissions of fact to NEXUS and its principle Sergio. Specifically, these DEFENDANTS (DELOZIER and C&J) worked with Sergio and engaged in extensive communications over the course of about a year in the form of emails, in-person meetings, and phone calls where they discussed, in-depth, specifications for products and proprietary technologies that these DEFENDANTS (DELOZIER and C&J) stated would be purchased from NEXUS after successful testing, and in exchange for know-how, technological improvements, and product development. These statements were false promises of future performance and

were known to be false, and made as a pretext for acquiring valuable information on NEXUS technological improvements, patent pending technology, and engineering experience that could be harnessed for the DEFENDANTS' own secreted purposes. At no time during this extensive relationship where confidential information was being exchanged and business being offered did DELOZIER or C&J make known to NEXUS that they were developing in secret their own products using NEXUS technology, which they would later release and call "the GameChanger™" based on NEXUS' information, engineering efforts, and then patent pending technology.

32. The aforementioned misrepresentations and omissions by DELOZIER and C&J were made with knowledge or recklessness as to falsity and with deceptive intent to induce reliance by NEXUS and Sergio. DELOZIER exploited the promise of future business as compensation to exact valuable information and product development from Sergio and NEXUS, all the while omitting critical facts about their own development of the (GameChanger™). Had NEXUS known the actual facts and *modus operandi* of DELOZIER and C&J, it never would have dealt with them or shared critical information.

33. NEXUS actually and justifiably relied on the misrepresentations and omissions by DELOZIER and C&J.

34. NEXUS has been proximately injured and actually damaged because of these misrepresentations and omissions. NEXUS has been damaged in the form of profits and royalties it might have earned from C&J, and has also now lost market share that belongs to NEXUS, to the extent DELOZIER and C&J harnessed NEXUS technology.

35. NEXUS' injury resulted from DEFENDANTS' actual fraud, gross

negligence, or malice, which entitles plaintiffs to exemplary damages under TEX.CIV.PRAC.REM.CODE §41.003(a). To the extent NEXTIER is a successor in interest of C&J, it is liable for the C&J's conduct and that of its former officers and directors.

VII. COUNT 4

(Negligent misrepresentation)

36. PLAINTIFF re-alleges the allegations contained in previous paragraphs as if fully set forth herein.

37. The elements of a cause of action for negligent misrepresentation of material facts include: (1) the representation made by a defendant in the course of his business, or in a transaction in which he has a pecuniary interest; (2) the defendant supplies "false information" for the guidance of others in their business; (3) the defendant did not exercise reasonable care or competence in obtaining or communicating the information; and (4) the PLAINTIFF suffers pecuniary loss by justifiably relying on the representation.

38. DELOZIER and C&J by and through their representative and employee, DELOZIER (who was an officer and director), made negligent misrepresentations, errors and omissions in their dealings with NEXUS and Sergio that were at least negligent. DELOZIER made false representations, as a representative of C&J, that NEXUS would be compensated in exchange for their access to valuable information on NEXUS technological improvements, patent pending technology, and engineering experience that could be harnessed for the DEFENDANTS' own purposes.

39. DELOZIER and C&J did not exercise reasonable care or competence in communicating with Sergio or NEXUS, and for the likelihood that NEXUS would act in

good faith on representations of future business as compensation in exchange for product development efforts.

40. PLAINTIFF has therefore been proximately damaged in the lost value of sharing its knowhow, technological improvements, patent pending technology and engineering experience, which should have resulted in profits in sales to C&J, and/or royalties, and market share for its own technology.

VIII. COUNT 5

(Breach of Contract)

41. PLAINTIFF re-alleges the allegations contained in previous paragraphs as if fully set forth herein.

42. The elements of a cause of action for the breach of contract are: (1) the existence of a contract; and, (2) breach. C&J breached express and/or implied contracts with NEXUS. Express and implied contracts require the element of mutual agreement, which in the case of an implied contract is inferred from the circumstances. The conception is that of a meeting of the minds of the parties as implied from and evidenced by their conduct and course of dealing, the essence of which is consent to be bound.

43. In the instant case, there was a mutual understanding between NEXUS and C&J that NEXUS would share valuable information on NEXUS technological improvements, patent pending technology, and engineering experience, in exchange for use and future business as compensation by C&J of NEXUS technology for a reasonable fee. NEXUS was not developing C&J specific products and sharing technology with the expectation that it would be for free, much less misappropriated and used in their own

unlicensed products.

44. C&J breached the contract it had with NEXUS. NEXTIER is the successor in interest of C&J and is therefore liable for C&J's breach.

45. NEXUS has been damaged as a result.

46. NEXUS seeks attorney fees by reason of breach of contract under TEX.CIV.PRAC.REM.CODE §38.001 *et seq.*

IX. COUNT 6

(Quantum Meruit)

47. PLAINTIFF re-alleges the allegations contained in previous paragraphs as if fully set forth herein.

48. The elements of this cause of *quantum meruit* are: (1) Plaintiff performed valuable services for the Defendant; (2) Defendant accepted, uses, and enjoys those services; and (3) under the circumstances, Defendant was reasonably notified that the Plaintiff expected payment for those services which, which the Plaintiff did not receive.

49. Plaintiff provided product design services to defendant. Plaintiff designed parts that could be used with Defendant's perforation guns. The parts, and the services and engineering used to implement them, were put into Defendant's perforation guns and successfully tested by Defendant. Defendant acknowledged that the product was successful. Defendant NEXTIER continues to sell the product designed by PLAINTIFF, and enjoying the benefit of the uncompensated labor and services.

50. Defendants knew that PLAINTIFF expected compensation for the services. PLAINTIFF was to be compensated in the form of part orders and business relationships.

DEFENDANTS presumptively intended to avoid paying plaintiff for the service because they produced a line of perforation guns using parts designed by PLAINTIFF, but which were not ordered through PLAINTIFF. DEFENDANTS failed to pay for the services even though PLAINTIFF provided defendant with notice.

51. NEXUS has been damaged as a result of DEFENDANTS' conduct. NEXTIER is the successor in interest of C&J and is therefore liable for C&J and its employee, DELOZIER's conduct. NEXTIER has benefited from the services taken from PLAINTIFF.

52. Plaintiff is entitled to recover reasonable and necessary attorney fees under Texas Civil Practice & Remedies Code section 38.001(1) to (3). Plaintiff retained counsel who presented a claim, and Defendants did not tender the amounts owed.

53. Plaintiff seeks damages within the jurisdictional limits of this Court.

X. COUNT 7

(Common Law Misappropriation)

54. PLAINTIFF re-alleges the allegations contained in previous paragraphs as if fully set forth herein.

55. The elements of a cause of action for misappropriation include: (1) Plaintiff created a product through his or her extensive time, labor, skill, and money; (2) Defendant free-rode on the Plaintiff's work by using the product to engage in direct competition; and (3) the Plaintiff is commercially damaged as a result.

56. In this case, PLAINTIFF designed parts for improving DEFENDANT'S perforation guns. The design of these parts involved considerable research and

development, know-how and engineering experience of PLAINTIFF. Furthermore, these parts were designed through Plaintiff's extensive time, labor, skill, and money. During the design process, DEFENDANTS did not provide any money to assist in the development of the parts. The parts were successfully tested by DEFENDANTS. DEFENDANTS were supposed to compensate PLAINTIFF for his efforts, but compensation was never provided. DEFENDANTS are free-riding on PLAINTIFF'S design efforts since parts have been and are presently used to improve DEFENDANT'S perforation guns.

57. NEXUS has been damaged as a result of C&J's original misappropriation. NEXTIER continues to exploit the misappropriated know how and engineering experience and, as the successor in interest of C&J, is therefore liable for C&J's and its misappropriation.

XI. COUNT 8

(Civil Conspiracy)

58. PLAINTIFF re-alleges the allegations contained in previous paragraphs as if fully set forth herein.

59. The elements of a cause of action for civil conspiracy include: (1) two or more persons; (2) object to be accomplished; (3) a meeting of minds on the object or course of action; (4) one or more unlawful, overt acts; and (5) damages as the proximate result.

60. In this case, DELOZIER and C&J conspired to trick NEXUS into disclosing its proprietary know-how and into developing parts that would implement the '136 technology in C&J's perf guns. DELOZIER met with NEXUS and made false promises to induce NEXUS' disclosures of know-how and development of parts for C&J's perf guns.

DELOZIER and C&J used NEXUS' disclosures to develop the GameChanger™. DELOZIER and representatives of C&J, and on information and belief, NEXTIER, had a meeting of the minds about the valuable technology they wanted to acquire from PLAINTIFF without having to pay fair market value for the products or services. They took one or more overt, unlawful, and unethical acts in furtherance of the conspiracy, and did in fact deprive PLAINTIFF of the value of his knowhow, trust and engineering experience.

61. NEXUS has been damaged as a result of C&J's original misappropriation. NEXTIER continues to exploit the misappropriated know how and engineering experience and, as the successor in interest of C&J, is therefore liable for C&J's and its misappropriation.

XII. COUNT 9

(Promissory Estoppel)

62. PLAINTIFF re-alleges the allegations contained in previous paragraphs as if fully set forth herein.

63. DEFENDANT C&J and DELOZIER promised PLAINTIFF that DEFENDANT would compensate it with future business and exclusivity in exchange for services, knowhow, and product designs adapted for its products. PLAINTIFF relied on DEFENDANTS' promises in this regard by delivering its services, products, and knowhow. Because of the nature of the promise, PLAINTIFF's reliance was both reasonable and substantial. DEFENDANTS C&J and DELOZIER knew, or reasonably should have known, that PLAINTIFF would rely on DEFENDANTS' promises to

exclusively order products from PLAINTIFF to fit its product lines. PLAINTIFF's reliance on DEFENDANT's promise resulted in injury to PLAINTIFF, which caused damages in the form of lost sales, and market share it could have sold or delivered elsewhere for fair market value.

64. PLAINTIFF seeks damages within the jurisdictional limits of the court.

65. PLAINTIFF is entitled to recover reasonable and necessary attorney fees under Texas Civil Practice & Remedies Code section 38.001(8) because this suit is for promissory estoppel. Plaintiff retained counsel, who presented the plaintiff's claims and the DEFENDANTS did not tender the amounts owed.

PRAYER FOR RELIEF

Wherefore, PLAINTIFF NEXUS demands judgment for itself and against DEFENDANTS as follows:

- A. An adjudication that the '136 Patent is valid;
- B. An adjudication that DEFENDANTS have infringed the '136 Patent;
- C. An award of damages to be paid by DEFENDANTS adequate to compensate PLAINTIFF for past infringement of the '136 Patent and any continuing infringement through the date such judgment is entered, including interest, costs, expenses, and an accounting of all infringement acts, including, but not limited to, those acts presented at trial;
- D. An award of damages to be paid by DEFENDANTS for their tortious conduct that damaged PLAINTIFF;
- E. An award of exemplary damages to be paid by DEFENDANTS consistent with

TEX.CIV.PRAC.REM.CODE §41.003(a).

- F. An injunction enjoining DEFENDANTS and their respective officers, directors, agents, servants, employees, affiliates, attorneys, and all other acting in privity or in concert with them from directly or indirectly infringing the '136 Patent;
- G. An award of enhanced damage in accordance with the patent laws for willful infringement;
- H. A declaration that DEFENDANTS' infringement is willful;
- I. A declaration that this case is exceptional under 35 U.S.C. § 285 and an award to PLAINTIFF of its reasonable attorney's fees;
- J. An award of prejudgment and post-judgement interest;
- K. An award of reasonable attorney fees as may be equitable or authorized by statute;
- L. An award of PLAINTIFF's costs of this litigation; and,
- M. An award to PLAINTIFF of such further relief at law or in equity as this Court deems just and proper.

JURY DEMAND

Pursuant to Federal Rules of Civil Procedure Rule 38(b), PLAINTIFF hereby demands a trial by jury on all issues triable as such.

Date: September 15, 2020

Respectfully submitted,

BUCHE & ASSOCIATES, P.C.

/s/ John K. Buche

John K. Buche (TX Bar No. 24012352)
Scott D. Compton (TX Bar No. 24032088)
BUCHE & ASSOCIATES, P.C.

1700 Post Oak Blvd., 2 Blvd. Pl., Suite 600
Houston, TX 77056
Tel.: (858) 459-9111
Fax: (858) 430-2426
jbuche@buchelaw.com

*ATTORNEY FOR PLAINTIFF NEXUS
PERFORATING LLC*

EXHIBIT A



US010352136B2

(12) **United States Patent**
Goyeneche

(10) **Patent No.:** **US 10,352,136 B2**

(45) **Date of Patent:** **Jul. 16, 2019**

(54) **APPARATUS FOR
ELECTROMECHANICALLY CONNECTING
A PLURALITY OF GUNS FOR WELL
PERFORATION**

(71) Applicant: **Sergio F Goyeneche**, Spring, TX (US)

(72) Inventor: **Sergio F Goyeneche**, Spring, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/312,120**

(22) PCT Filed: **May 15, 2015**

(86) PCT No.: **PCT/US2015/031047**

§ 371 (c)(1),

(2) Date: **Nov. 17, 2016**

(87) PCT Pub. No.: **WO2016/186611**

PCT Pub. Date: **Nov. 24, 2016**

(65) **Prior Publication Data**

US 2018/0119529 A1 May 3, 2018

(51) **Int. Cl.**

E21B 43/117 (2006.01)

E21B 43/118 (2006.01)

E21B 43/119 (2006.01)

E21B 43/263 (2006.01)

F42B 1/036 (2006.01)

(52) **U.S. Cl.**

CPC **E21B 43/117** (2013.01); **E21B 43/118** (2013.01); **E21B 43/119** (2013.01); **E21B 43/263** (2013.01); **F42B 1/036** (2013.01)

(58) **Field of Classification Search**

CPC E21B 43/117; E21B 43/118; E21B 43/119;
E21B 43/263; E21B 43/11; E21B 43/114;
E21B 43/116; F42B 1/036
USPC 89/1.151, 1.15; 175/4.55, 4.56, 4.57,
175/4.58, 4.59; 102/320, 314, 315, 319,
102/321

See application file for complete search history.

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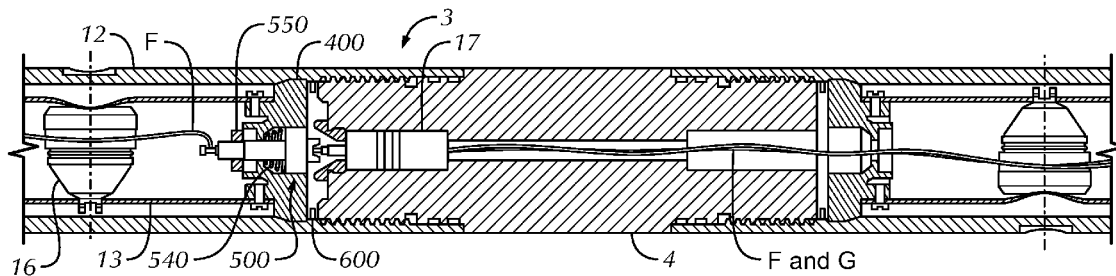
Primary Examiner — John Cooper

(74) *Attorney, Agent, or Firm* — The Law Offices of
Kevin M. Jones & Associates, LLC

(57) **ABSTRACT**

A gun assembly for perforating wells comprising a plurality of guns with shape charges aligned centrally by end caps having insulated connector pins for conducting electrical signals and pressure through the end caps while preventing debris from the blast of one gun from entering and damaging the electrical connections and components of the next gun. The end caps being interconnected physically and electrically by specialized intermediate subs.

17 Claims, 7 Drawing Sheets



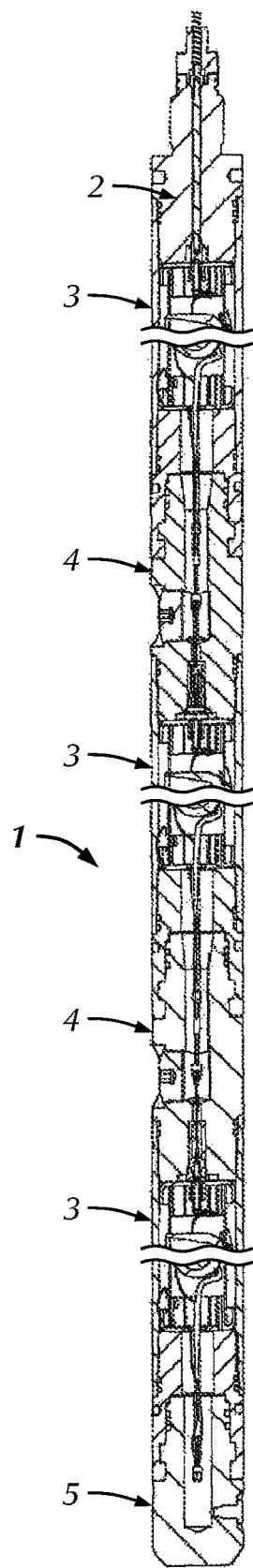


FIG. 1
(Prior Art)

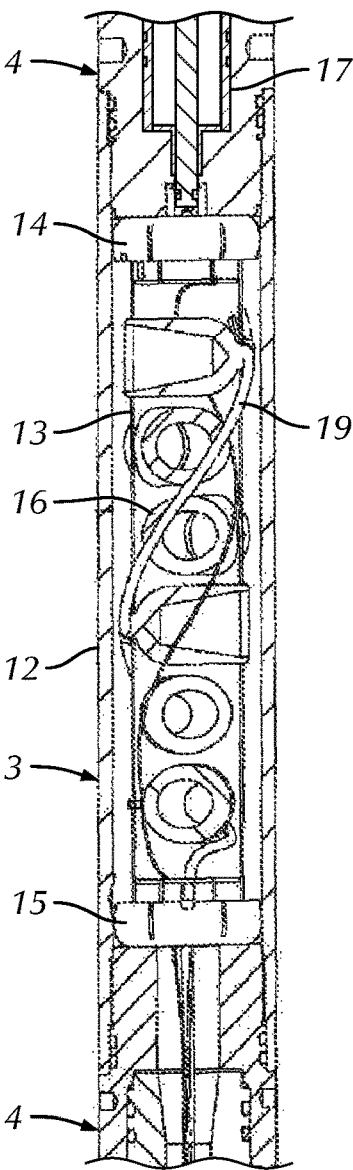


FIG. 2
(Prior Art)

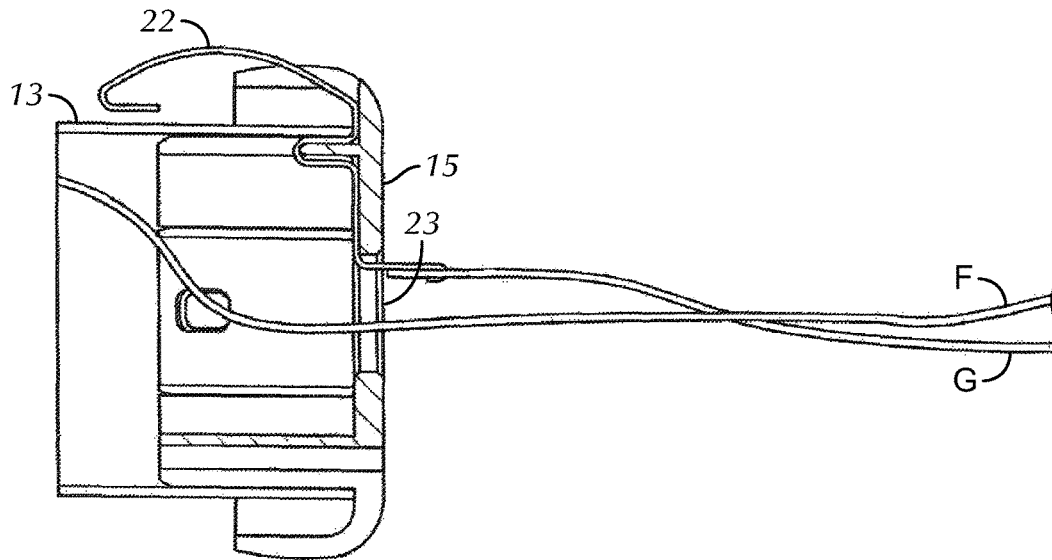


FIG. 2A
(Prior Art)

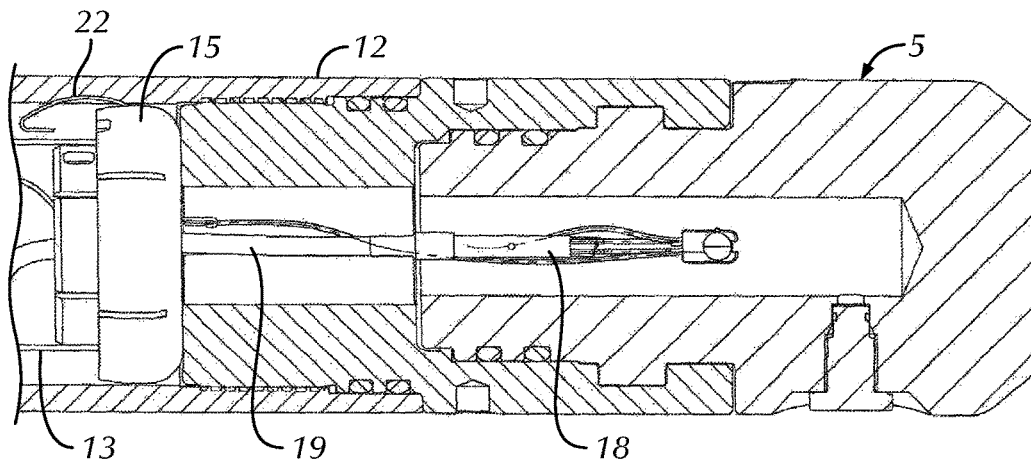


FIG. 2B
(Prior Art)

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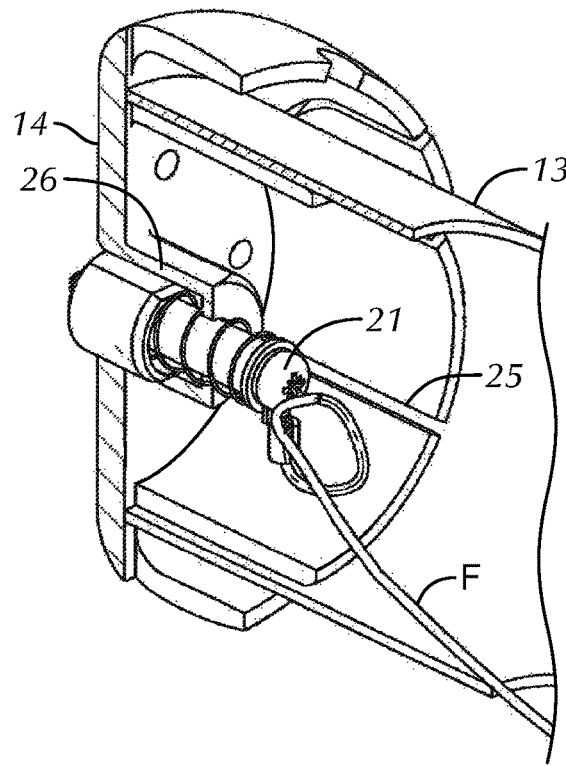


FIG. 3A
(Prior Art)

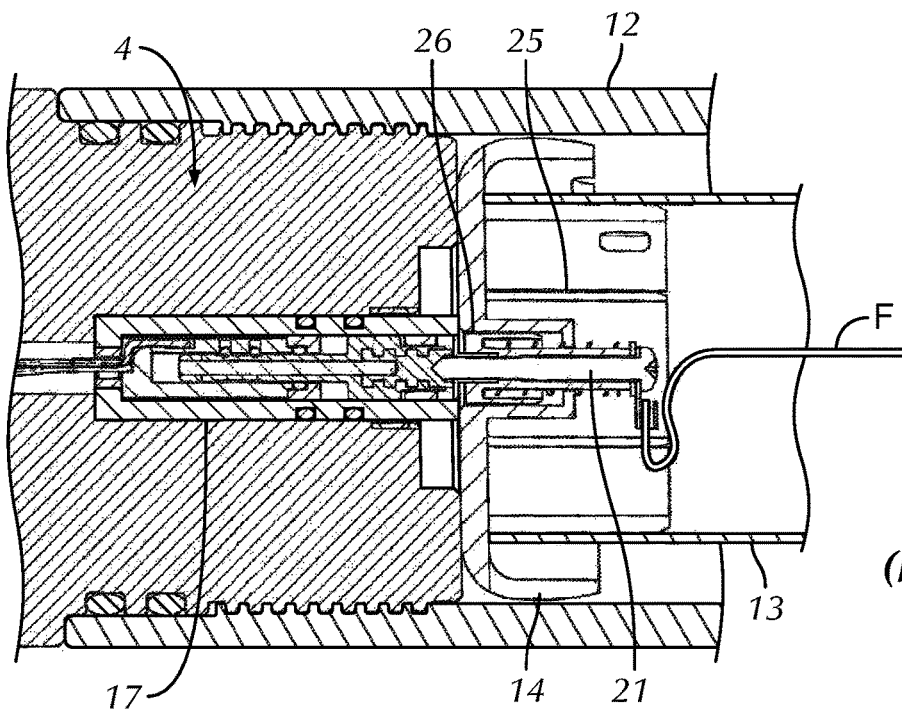


FIG. 3B
(Prior Art)

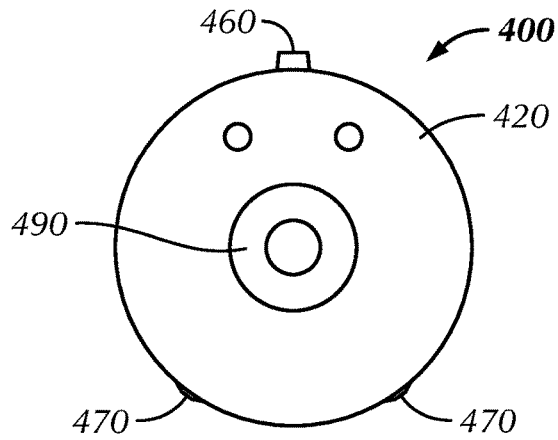


FIG. 4A

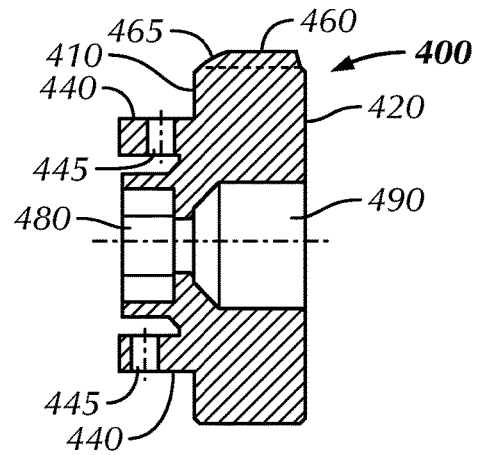


FIG. 4B

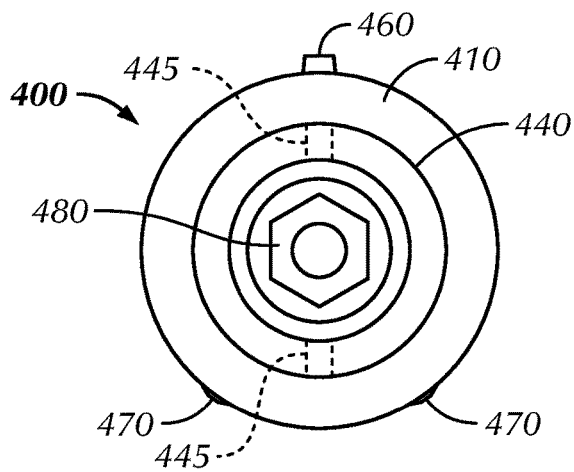


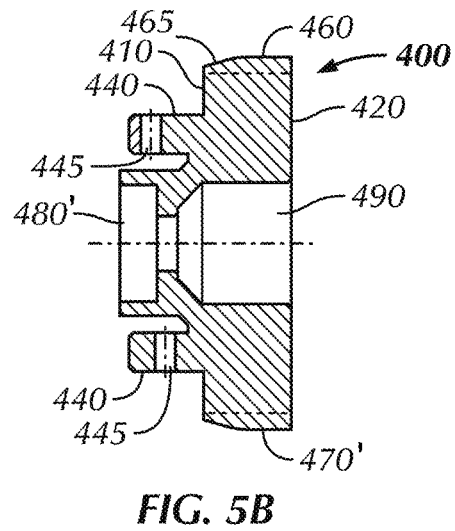
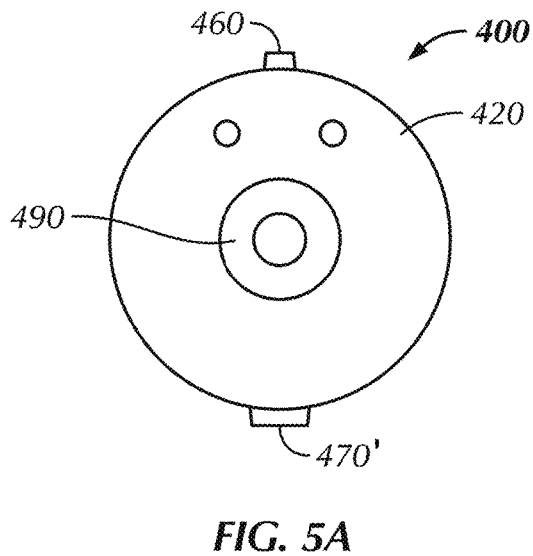
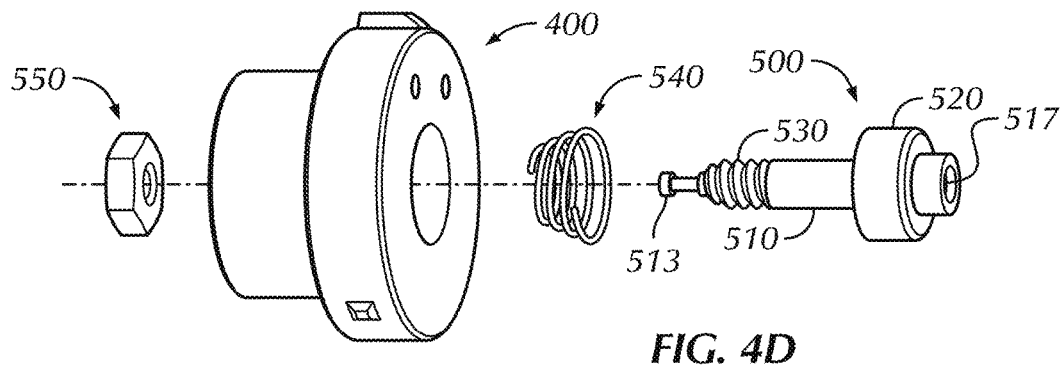
FIG. 4C

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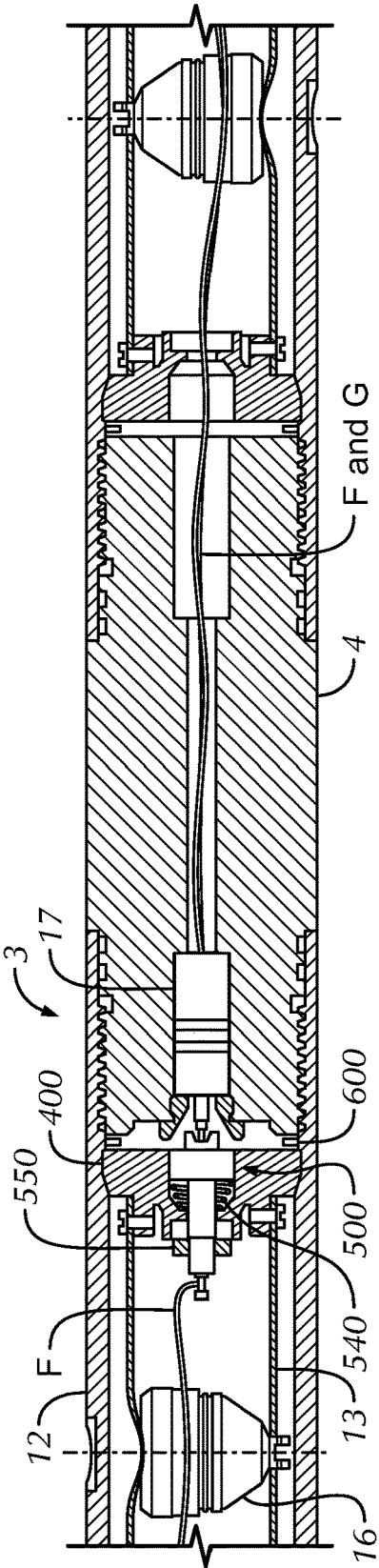
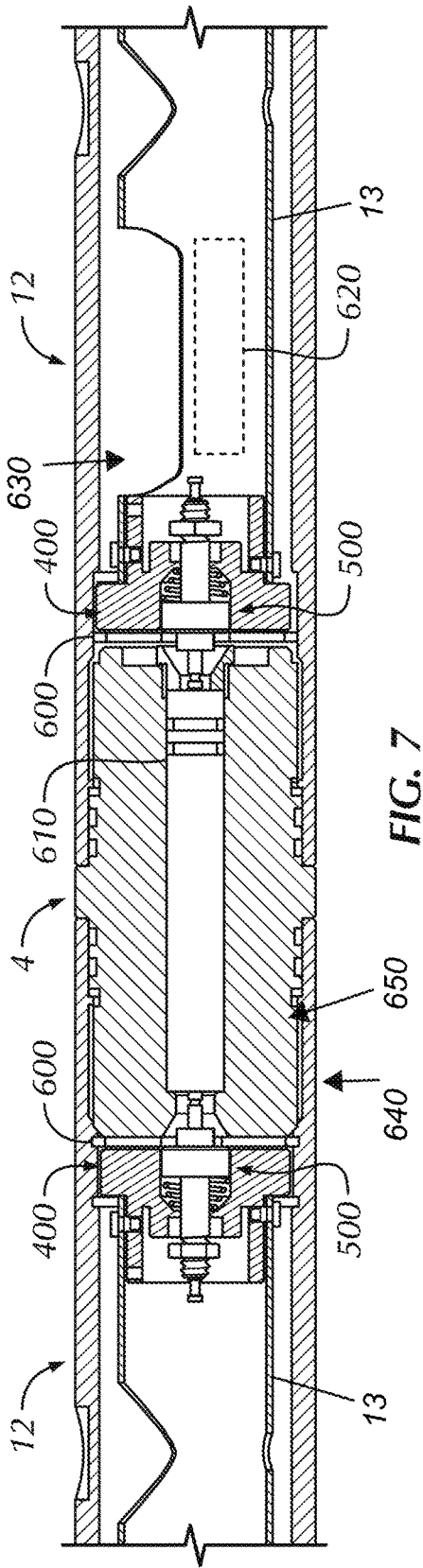


FIG. 6



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APPARATUS FOR ELECTROMECHANICALLY CONNECTING A PLURALITY OF GUNS FOR WELL PERFORATION

CROSS-REFERENCE TO RELATED APPLICATIONS

Not Applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable.

BACKGROUND OF THE INVENTION

Field of the Invention

This invention refers in general to an integral assembly (a “perf assembly”) of a plurality of perforating guns (“guns”) containing a plurality of shape charges (“charges”). This perf assembly is used in perforation of wells. This invention is particularly directed to a new electro-mechanical assembly for connecting a series of guns to allow reliable assembly and reliable sequential firing of the guns during the perforation process of production wells. This process of well perforation consists of the perforation of the metallic casing of a well, of isolating the cement surrounding the casing, and of the layers of rock in the producing formation by means of explosives housed within perforating guns; achieving, through bore holes produced by a plurality of charges, a connection between the depths of the producing zone and the interior of the well. While this invention is generally found in the petroleum production industry, it may be equally applied to other environments where perforation of well casing into the surrounding environment is necessary, such as water wells.

Background of the Invention

The perforation of producing wells is realized by lowering into the well a perf assembly comprised of a plurality of guns each containing a plurality of charges. A firing wire, coupled with the casing as a ground, carries an electrical signal through the well bore to connect with each gun and allow firing of the detonators. The detonators may be fired through independently addressable switches or through a series of pressure switches and diodes which isolate each gun until the desired firing event.

One method of independently firing the guns is to use individually addressable detonators such as those described in U.S. Pat. Nos. 8,091,477 and 8,230,788. Another method of independently firing the guns is to connect each gun through a pressure sensitive switch which grounds the detonator of each gun until the pressure of the previous gun’s firing triggers the switch to an active state. Further, diodes are used to cause each gun to require a polarity reversal from the signal which fired the previous gun. This prevents the signal from propagating throughout the assembly as the blasts set each pressure switch.

This method requires a continuous electrical signal to run the length of the perf assembly. However, wires are often twisted, broken, or can pull loose during the assembly process during the act of screwing the subs together. This results in the assembly having to be deconstructed and repaired. Additionally, weakened wires may pass initial test

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during construction only to fail during the process of lowering the assembly to depth, or due to vibrations of early charges in the sequence.

The preferred method is to fire the farthest/lowest gun first. Then, sequentially fire each gun back toward the well opening. This is because the explosion/pressure/debris from one gun’s firing can possibly damage neighboring guns. Wires can break or connectors can loosen during shockwave vibrations, or by blast force. With pressure switches, any damage requires retrieval of the perf assembly for correction, as the rest of the assembly is now non-fireable. Addressable switches allow a damaged section to be skipped, but still result in unfired guns. Unfired guns are highly undesirable, as they are hazardous to bring to the surface due to the dangers of handling explosives which are not known to be in a safe condition or state.

To fulfill the operation so briefly described above, while simultaneously respecting existing norms for the manipulation of explosives, highly capable operators are required to arm and assemble the guns and the wellhead, stripping the ends of connecting wires and joining them by twisting the exposed portions of the wire together and covering the joint with adhesive electrical tape, resulting in an ‘artisanal’ activity requiring extreme caution.

It should be noted that petroleum production and exploration activities are generally located in areas with hostile climatic conditions for the operators; work hours are assigned in accordance to the needs of the operation and may include nighttime and daytime hours, with extreme cold or heat, rain or wind, darkness or sunlight. Hours are controlled by working against the clock and by penalizing setbacks; to that respect, it is absolutely necessary that the strictest safety norms be followed while handling explosive material; all of these factors together contribute to an increased likelihood that operators may commit errors while wiring or assembling the guns into a perf assembly to be introduced into the well. Further, even if the operators do everything correctly, the actions required to connect the pipe sections that make up the perf assembly may still produce a costly mistake.

From the above facts, there exists an obvious need to simplify the operation of arming and joining the guns into a perf assembly. There is also a need to ensure that the firing of one gun does not introduce faults into the remaining portions of the perf assembly preventing the required firing sequence. The object of this invention deals with the means to perform the electromechanical connection of the gun assembly.

SUMMARY OF THE INVENTION

Facing the current state of the techniques on the subject, an improved assembly for use in petroleum producing wells is proposed where a rigid end plate design aligns insulated contact pins, which couple with pressure switches to carry the pressure from one charge through the end plates to set the pressure switch of the next gun, while protecting the next gun from damaging debris of the explosion.

Currently in the industry a plastic insulating bottom end cap attaches to the charge carrier, and approximately centers it within the body. The bottom end cap has a central hole through which passes a wire carrying the electrical firing signal. A second wire connects to a grounding pin affixed to the plastic end cap which is routed to brush against the gun body to establish a ground.

The distal end of the charge carrier has a different plastic insulating end cap, called a top cap, which attaches to the charge carrier, and approximately centers it within the gun

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body. The top end cap has a screw with a wire lug attached to the distal end of the signal wire passing from the bottom end cap. The screw passes through the top end cap to contact the pressure switch for the next gun. The wire lug is a common breaking point if the wire does not absorb the twisting of the assembly process.

The innovation includes replacing the traditional plastic end caps on each charge carrier with an improved design which is more robust and reliable in the assembly of multiple guns into a single perf assembly. The improved gun end cap comprises the majority of the improvements which form the basis of this invention.

The improved gun end caps, in the preferred embodiment, are machined from aluminum and comprise a through hole in the center. A guiding pin extends laterally and runs from outer face to the inner face of the end cap, being beveled on the inner edge to facilitate assembly. The guiding pin engages a slot in the gun body to align the charges. The inner face has an edge extending from the inner face and, a charge carrier mating surface which engages the inner diameter of the charge carrier and is secured thereto.

At least one secondary guide point extends from the end cap to force the guiding pin into the slot; to ensure grounding contact between the end cap and the gun body; center the end cap within the gun body; and reduce friction between the end cap/gun body interface during assembly by reducing the contact surfaces. In one embodiment, a single guiding point is position counter to the guide pin and is substantially wider than the guide pin to prevent it from mistakenly being assembled into the slot.

In the preferred embodiment, two secondary guiding points extend from the end cap edges approximately one hundred and twenty degrees (120°) apart from the principle guide pin. In addition to ensuring contact with the gun body for grounding of the electrical signal, the guide pin and guide points ensure centering of the contact pin within the gun body so that proper alignment with the subs is achieved.

The through hole in the center of the bottom end cap may remain open for wires to pass through for connection to the detonator as with the plastic end cap system, however there is no need for the grounding pin, as the wire may be attached directly to the face of the end cap via a screw. Since the aluminum is conductive, it grounds to the gun body. The signal wire passes through the gun body to attach to a contact pin.

The through hole in the center of the top end cap has a contact pin biased outward via a spring, and retained by a locking nut. In the preferred embodiment, the pin is aluminum and is coated in an insulating plastic to isolate it electrically from the end cap, allowing it to conduct the electrical signal from the wire to the plunger of the pressure switch which contacts the pin's recessed external end. The spring biases the pin to project outward from the outer side, and allows it to compress inward during the assembly process as the subs are joined, and to account for minor variances in length of the components during manufacturing. The outward force of the spring ensures the pin remains in electrical contact with the next gun's pressure switch, but without exerting enough force to engage said pressure switch.

The pin is secured by a locking nut on the inner side of the end cap, which sits in a hex shaped recess on the inner surface of the end cap. This hex shaped recess eliminates the need for tooling when the device is assembled. Further, the matching nut and end cap recess ensures blast pressure does not escape around the pin, but instead it acts on the pin to shift it outwardly to engage the pressure switch of the next

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gun. One skilled in the art would appreciate that other shapes would accomplish the same task as the hex nut and recess employed herein.

Where addressable switches are employed, a pressure switch may be replaced with a conducting axial rod with insulating sheath, as found in a traditional firing head or top sub. This axial rod is housed in a Tandem Sub and extends the signal from one gun to the next by mating with the pins in each end cap. The pins in the end cap mate via contact which allows the pins of the axial rod to sit in the recessed ends of the pins, and is secured by pressure from the spring.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-section of an assembly of three armed and assembled guns in a manner that is in accordance with this invention.

FIG. 2 shows a cross section of a single gun joined on each end with a tandem sub.

FIG. 2A shows an insulator cap assembly prior to mating with the gun or sub.

FIG. 2B shows a bottom sub assembly containing a detonator attached to a bottom sub and mated with a gun.

FIG. 3A shows the wired retractable contact pin installed into an insulating top end assembly prior to mating with a sub.

FIG. 3B, is another detailed view of a tandem sub, showing the end cap of the gun and pressure switch of the tandem sub in their respective positions in the gun assembly.

FIGS. 4A, 4B, and 4C are views of an end cap in accordance with an exemplary embodiment of the innovation.

FIG. 4D is an exploded view of the end cap and contact pin assembly in accordance with an exemplary embodiment of the innovation.

FIGS. 5A and 5B are views of an alternative embodiment of an end cap in accordance with an exemplary embodiment of the innovation.

FIG. 6 is a cross section of an end cap assembly in gun body, and joined with a sub employing a pressure/diode switch in accordance with an exemplary embodiment of the innovation.

FIG. 7 is a cross section of an end cap assembled in a gun body employing addressable switches in accordance with an exemplary embodiment of the innovation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following is a detailed description of exemplary embodiments to illustrate the principles of the invention. The embodiments are provided to illustrate aspects of the innovation, but the invention is not limited to any embodiment. As those skilled in the art will appreciate, the scope of the invention encompasses numerous alternatives, modifications, and equivalent; it is limited only by the appended claims.

In relation to FIG. 1, the perf assembly (1) has a firing head (2), three perforating guns (3), each containing a charge carrier, two tandem subs (aka subs) (4), and a bottom sub (5). The mentioned parts are tubular pieces provided at the ends of the elements of the machined joint that will be described briefly, as they are not included within the sphere of protection of this innovation.

One skilled in the art would be aware with the composition of drill strings which comprises one or more of the following: drill pipe, subs, drill collars, stabilizers, shock

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absorbers, tools, reamers, bits, and other in-hole equipment. One skilled in the art would be aware the overwhelming majority of these items utilize Rotary Shouldered Threaded Connections which are commonly referred to as “pin and box” connections. One skilled in the art would appreciate that the male (externally threaded) version is commonly referred to as a “pin” or “pin fitting”, and the female (internally threaded) version is commonly referred to as a “box” or “box fitting”, and they are generally manufactured to specifications developed and approved by the American Petroleum Institute, which includes internal and external diameters, wall thicknesses, upset dimensions, nominal size, weight, and grade as well as tool joint type, to ensure joint mating of similar products manufactured by different companies. All references to drill pipe, subs, collars, bits, etc. are referred to in conformity with API usage unless otherwise specifically designated herein.

FIG. 2, shows a gun (3) which comprises a charge carrier (13) with a plurality of explosive shape charges (16) joined by a detonation cord or fuse (19). The charge carrier (13) is supported, substantially centered, within the gun body casing (12) by an insulating top end (14) and an isolating bottom end (15). More detail of the centralizing end plates will be provided below.

One can see in the interior of the carrier (13) that the shaped charges (16) are shown set in radial fashion, that is to say, perpendicular to the gun wall, to the carrier, and, when the guns are within the well, to the well casing. In the illustration, six shape charges are illustrated, but the actual number and orientation vary.

The shaped charges are explosives set in such a manner that they concentrate the force of the explosion outward, generating a jet of gas (plasma) at high pressure and temperature, that pulls the metal from the interior of the charge and projects it outward until it arrives at the well formation; with this action the charges produce a perforating effect that is variable in proportion to the potency of the charges.

In each intermediate joint or intermediate sub or tandem sub (4) one can see the pressure activated changeover switch (17), from which wires extend to the rest of the assembly. When the detonator is activated, a detonation is propagated by way of a “fuse”—or detonating cord (19)—to each of the shaped charges in the carrier (13) that burst in simultaneous fashion within the corresponding gun (3). Although not described in detail herein, the internal details of the assembly are protected by a watertight seal, otherwise the liquids present in the well would enter into the interior of the gun causing problems with the electric and/or ballistic systems.

In FIG. 2A, the insulating end plate is represented as being attached to the lower end of the charge carrier (13), and has a tab for connecting the ground wire (22) from the carrier to the interior of the gun housing; furthermore, it has a hole, or central orifice, (2) that permits the passage of a pair of wires, ‘live’ or ‘fire’ (F) and ‘ground’ (G). These wires are connected to the components in the next tandem immediately below to pass the signal throughout the assembly (1, not illustrated) as required by the electronic configuration thereof. One skilled in the art will appreciate that these wires can be connected by stripping/twisting/taping; by electrical nuts; or by specialized contact connectors. It is important that the wires be connected correctly and securely to ensure they do not become loose during the handling, break during the assembly process, or short against the housing.

In FIG. 2B, the insulating end plate (15) centers the charge carrier (13) and causes the grounding contact (22) to connect with the gun body (12) represented as being attached to the lower end of the charge carrier (13), and has

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a tab for connecting the ground wire (22) from the carrier to the interior of the gun housing; furthermore, it has a hole, or central orifice, (23) that permits the passage of a pair of wires, ‘live’ or ‘fire’ (F) and ‘ground’ (G). These wires are connected to the components in the next tandem immediately below to pass the signal throughout the assembly (1, not illustrated) as required by the electronic configuration thereof. One skilled in the art will appreciate that these wires can be connected by stripping/twisting/taping; by electrical nuts; or by specialized contact connectors. It is important that the wires be connected correctly and securely to ensure they do not become loose during the handling, break during the assembly process, or short against the housing.

In FIG. 3A the end plate (14) with the retractable contact pin (21) is shown attached on the upper end of the charge carrier (13). From the top of the end plate (14) protrudes a moving contact point that will make contact with the bottom side of a pressure switch (17, not shown) for the next component in the perf assembly (1, not shown), to allow the passage of the “live” wire towards the bottom. The tension from the spring urges the contact pin outward from the charge carrier (13) to adapt to any movement of parts and/or differences in length.

The end plate (14) is a tubular piece of plastic with peripheral skirt, bearing a groove (25) that allows it to adapt and center the carrier (13) within the tolerances set by the perforating gun tube provider. The end plate (14) possesses a central tubular portion (26) for mounting the retractable contact pin (21), which contains a screw that connects the fire line (F) to the next device.

In FIG. 3B the end plate (14) is shown in the assemble position. The end plate (14) with the retractable contact pin (21) is shown, and is represented on the upper end of the charge carrier (13). From the top of the end plate (14) protrudes a moving contact point (21) that will make contact with the piece above the carrier, shown herein as a pressure switch (17) set in a tandem sub (4). The retractable contact pin (21) is centered by the central tubular portion (26). Flexible grooves (25) anchor the end plate (14) in the charge carrier (13) and the peripheral skirt centralizes the assembly in the gun body casing (12). The signal fire wire (F) has slack to prevent breaking during the threading process of assembling the gun body casing (12) to the tandem sub (4).

FIGS. 4A, 4B, 4C, and 4D show a front, side cross section, back, and exploded view of an improved end cap in accordance with an exemplary embodiment of the innovation. The end cap (400) is manufactured from a durable solid material which is electrically conductive. In the preferred embodiment the end cap is manufactured from aluminum. The end cap (400) comprises an inner face (410) which is installed toward the charge carrier, and an outer face (420) which is directed toward the mating tandem sub during assembly. From the inner face (410) protrudes a circular projection, the charge carrier mating surface (440) which fits into the end of the charge carrier (13, not shown) and is secured by screws via the holes (445) in the charge carrier mating surface (440).

The end cap has a through hole for receiving the insulated contact pin (500). On the inner face (410) there is a void for receiving the nut which secures the contact pin. This void, hex shaped in the preferred embodiment (480), should match the shape of the nut so as to prevent blast pressure from escaping around it easily. The outer face (420) has a round void (490) for receiving a spring (540) and the pin (517). The spring (540) urges the contact pin (500) outward

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from the outer surface (420), but the pin (500) is retained by the nut (550) secured to the threads (530) at the inner surface (410).

The pin is coated in an insulating coating (520) which allows the fire signal wire (F) connected to the pin's (500) contact head (513) to pass the electrical signal through the pin body (510) to the pin base (517) where it contacts the next component in the assembly (100, not shown) without grounding against the end cap (400) which is in contact with the gun body casing (12, not shown).

In this embodiment, two secondary guide points (470) extend from the end cap edges approximately one hundred and twenty degrees (120°) apart from the principle guide pin (460). In addition to ensuring contact with the gun body for grounding of the electrical signal, the guide pin (460) and guide points (470) ensure centering of the contact pin (500) within the gun body so that proper alignment with the subs is achieved.

FIGS. 5A and 5B show an inner side and a side cross sectional view of an alternative embodiment of the end cap. The end cap (400) has a round opening (480') for the locking component of the contact pin. In this embodiment, a washer may be utilized with the nut. The spring opening (490), charger carrier mating surface (440) and screw holes (445) are the same as in the previous embodiment. The guide pin (460) remains the same situated on the edge of the end cap, extending from the inner surface (410) to the outer surface (420) with a bevel (465) on the inner surface side to ease insertion into the gun body casing (12, not shown).

A single secondary guide point (470') extends from the end cap edge to force the guide pin (460) into the slot: to ensure grounding contact, align the charges, and center the end cap within the gun body; and reduce the friction between the end cap/gun body during assembly by reducing the contact surfaces. In this embodiment, the single guide point (470') is positioned counter to the guide pin (460) and is substantially wider than the guide pin (460) to prevent it from mistakenly being assembled into the alignment slot of the gun body.

FIG. 6 shows a cross section of an intermediate sub incorporating a pressure switch with perforating guns mounted at either end. The perforating guns (3) mate to either end of the tandem sub (4) via screwing interface and pass the wiring signals (F & G) throughout the perf assembly (1, not indicated). The end cap (400) may be used at either end of the charge carrier (13). In the bottom end the center of the end cap (400) is left open so the firing wire (F) may pass from the pressure switch (17) to the detonator (18, not shown). In the top end the center of the end cap (400) contains the insulated contact pin (500) which is biased outward by the spring (540) and retained by the nut (550) to remain in contact with the pressure switch (17). The end cap (400) is held in position in the gun body casing (12) with a spring clip (600).

FIG. 7 shows a cross section of an intermediate sub for use with addressable switches with perforating guns mounted at either end. The perforating guns (3, not indicated) mate to either end of the tandem sub (4) via screwing interface and pass the wiring signals (F & G) throughout the perf assembly (1, not indicated). The center of the end caps (400) contains the insulated contact pin (500) which is biased outward by the spring (540) and retained by the nut (550) to remain in contact with the feed through pin (610) which is also insulated to keep the fire signal isolated from the grounded body of the gun body casing (12) and tandem sub (4). The end cap (400) is held in position in the gun body casing (12) with a spring clip (600). This means the length

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of the charge carrier (13) and end caps (400) will be less than the length of the gun body casing (12) so the pin fittings (650) of the neighboring component, a tandem sub (4) in this embodiment, can properly mate with the box fittings (640) of the gun body casing (12). The firing signal is passed directly between guns (3, not indicated) through the tandem sub (4) to the addressable switch (620), since pressure switches are not required in this embodiment. The wiring for the addressable switch (620) or pressure switch and detonator (17 and 18, not shown) being located internal to the charge carrier and accessible by the wiring port window (630) for installation and wiring, usually done during on-site final assembly, without disassembling and possibly misaligning the charges or damaging the wiring in the charge carrier.

The diagrams in accordance with exemplary embodiments of the present invention are provided as examples and should not be construed to limit other embodiments within the scope of the invention. For instance, heights, widths, and thicknesses may not be to scale and should not be construed to limit the invention to the particular proportions illustrated. Additionally, some elements illustrated in the singularity may actually be implemented in a plurality. Some element illustrated in the plurality could actually vary in count. Some elements illustrated in one form could actually vary in detail. Such specific information is not provided to limit the invention.

The above discussion is meant to be illustrative of the principles and various embodiments of the present invention. Numerous variations and modifications will become apparent to those skilled in the art once the above disclosure is fully appreciated. It is intended that the following claims be interpreted to embrace all such variations and modifications.

What is claimed is:

1. A gun assembly for perforating wells comprising:

at least one gun body casing, the casing being a hollow cylinder, with a box fitting at each end;

a charge carrier, the carrier being a hollow cylinder, with exterior diameter less than the interior diameter of the casing, and a length shorter than the distance between the box fittings of the casing;

a plurality of shape charges positioned radially inside the charge carrier and inter connected by a detonator cord;

a plurality of end caps affixed to the ends of the carrier and axially aligning the carrier within the casing between the box fitting ends, and secured therein;

at least one end cap being of a durable material, electrically conductive and electrically connects the charge carrier of the gun body;

an addressable detonation switch electrically connected between an inner side of at least one end cap and the plurality of shape charges within the charge carrier.

2. The assembly of claim 1 wherein at least one end cap comprises a guide pin along the edge of the end cap;

the guide pin seating into a groove on the interior of the casing aligning the charge carrier within the gun casing.

3. The assembly of claim 1 wherein the end caps further comprise:

a metallic body;

the body further comprising:

an extended cylindrical ridge protruding from one face, the ridge fitting into the interior diameter of the charge carrier tube, and being secured thereto.

4. The assembly of claim 3 wherein securing the charge carrier tube to the end cap is by pinning or screwing through the body of the tube into end cap.

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5. The assembly of claim 3 wherein the end caps further comprise:

- a charge pin passing through a centralized opening, the charge pin comprising:
 - a conductive core,
 - a contact pin and a threaded shaft at one end, and
 - a contact mating surface within an enlarged body on the distal end;
- an electrically insulating coating;
- the charge pin being biased to one side by a spring between the cap body and the charge pin's enlarged body, and retained within the centralized opening by a nut, threaded on the threaded shaft on the opposite side of the end cap.

6. The assembly of claim 5 wherein the charge pin nut loosely fits into a shaped void in the end cap to prevent blast pressure from passing through the end cap's centralized opening.

7. The assembly of claim 5 wherein the assembly further comprise: an intermediate sub mated to the gun assembly at a proximal end of the intermediate sub, wherein the intermediate sub comprises:

- a pin fitting mating with the box fitting of the gun body casing;
- a pressure switch, the pressure switch being centrally mounted at one end of the intermediate sub; and
- contacting the contact mating surface of the contact pin in the end cap of the gun.

8. The assembly of claim 7 wherein the intermediate sub further comprises:

- a detonator.

9. The assembly of claim 8 wherein the assembly further comprises:

- a second gun assembly mated to a distal end of the intermediate sub;
- the second gun assembly having an end cap without a contact pin on the mating end, thereby leaving an open end cap;
- wherein electrical cables of the pressure switch extend through the open end cap of the second gun assembly to electrically connect the gun assemblies together.

10. The assembly of claim 5 wherein the assembly further comprise:

- an intermediate sub mated to the gun assembly, wherein the intermediate sub comprises:
 - a pin fitting mating with the box fitting of the gun body casing;
 - a feed through pin in the intermediate sub which is electrically insulated from the body of the intermediate sub, the feed through pin being centrally mounted and extending substantially the length of the intermediate sub; and
 - contacting the contact mating surface of the contact pin in the end cap of the gun.

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11. The assembly of claim 5 wherein the assembly further comprises: an intermediate sub mated to the gun assembly at a proximal end of the intermediate sub, wherein the intermediate sub comprises:

- a pin fitting mating with the box fitting of the gun body casing;
- an addressable detonation switch;
- a feed through pin in the intermediate sub which is electrically insulated from the body of the intermediate sub, the feed through pin being centrally mounted and extending substantially the length of the intermediate sub; and
- contacting the contact mating surface of the contact pin in the end cap of the gun.

12. The assembly of claim 11 wherein the assembly further comprises:

- second gun assembly mated to a distal end of the intermediate sub;
- the second gun assembly also having an end cap with a contact pin;
- the feed through pin in the intermediate sub contacting the contact mating surface of the contact pin in the end cap of the second gun assembly to electrically connect the gun assemblies together.

13. The assembly of claim 5 wherein the assembly further comprises: an intermediate sub mated to the gun assembly at a proximal end of the intermediate sub, wherein the intermediate sub comprises:

- a pin fitting mating with the box fitting of the gun body casing;
- a feed through pin in the intermediate sub which is electrically insulated from the body of the intermediate sub, the feed through pin being centrally mounted and extending substantially the length of the intermediate sub; and
- contacting the contact mating surface of the contact pin in the end cap of the gun.

14. The assembly of claim 13 wherein the assembly further comprises:

- a second gun assembly mated to a distal end of the intermediate sub;
- the second gun assembly also having an end cap with a contact pin;
- the feed through pin in the intermediate sub contacting the contact mating surface of the contact pin in the end cap of the second gun assembly to electrically connect the gun assemblies together.

15. The assembly of claim 3 wherein the end caps further comprise:

- a mounting point for an electrical ground connector.

16. The assembly of claim 15 wherein the mounting point on the end caps is a threaded hole for screwing a wire lug thereto.

17. The assembly of claim 15 wherein the mounting point on the end caps is a snap connector or connecting pin.

* * * * *

EXHIBIT B



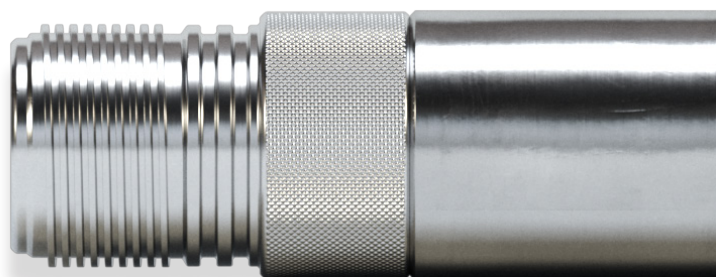
RETHINK YOUR PERF OPERATIONS.



Plug-and-play simplicity in the field. Reliable connections downhole.

Looking for a perforating system that can boost your operational efficiency by improving ease of use, increasing reliability and reducing NPT? You've found it. The GameChanger perforating system from C&J Energy Services features addressable switches and an innovative design that practically eliminates misruns caused by problems within the perforating gun.

It has no restrictive ports that can limit access, crimp electrical connections or cause flooded guns. Plug-and-play connections mean there are no wires running from gun to gun, which eliminates pinch points and provides a high level of confidence in the wellbore. Its compact design makes the tool string safer to handle on the job site. All in all, it takes your perforating game to a whole new level.



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**C&J ENERGY
SERVICES**

GAME-CHANGING BENEFITS

RELIABLE FIRING CONNECTIONS

- Port-free design prevents getting stuck from a loose port plug, eliminates wiring pinch points and significantly decreases chances of gun flooding
- Spring-loaded connectors provide automatic, solid contact between guns and subs
- Addressable switches confirm that each gun is working throughout the downhole descent
- Detonators and addressable switches located inside the gun – rather than in the sub – eliminates wires getting pinched or scraped

REDUCED NPT

- No port plugs in the gun system eliminates risk of fluid intrusion or port-plug blowouts
- Plug-and-play connections, combined with easy arming, eliminates wires between guns and subs, which removes potential pinch points
- Single-use components (CCL-to-gun sub and plug shoot sleeve) enhance reliability
- Reliable design means fewer misruns and trip-outs

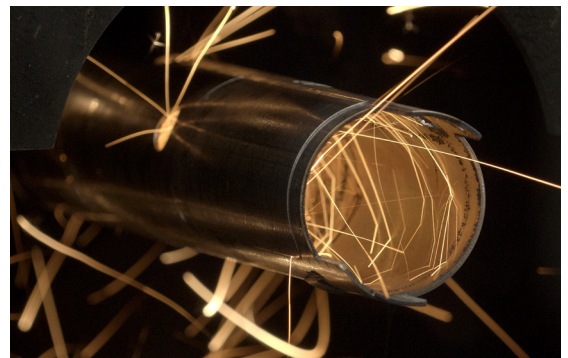
SHORT, DURABLE SUBS

- Simple design is easy to clean and reuse on-site
- Strong construction holds up blast after blast
- Shorter subs reduce string length and weight, which provides safer on-site handling and greater efficiency



Built to the highest standards in the C&J Research & Technology Center.

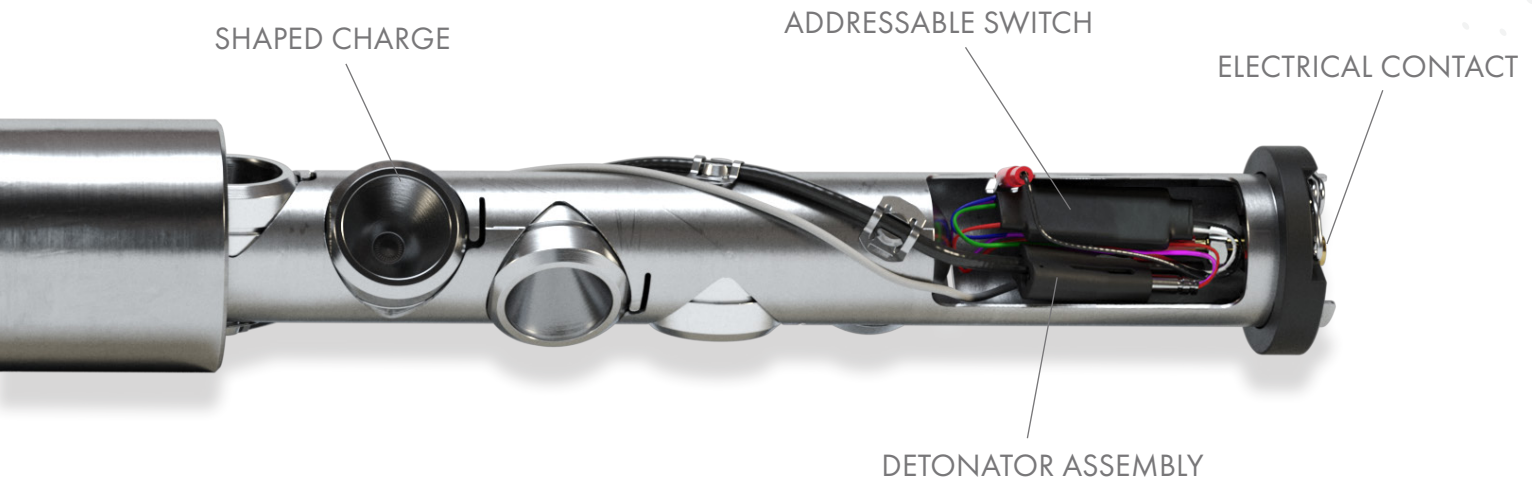
C&J designs and manufactures all GameChanger perforating systems with the utmost attention to quality control, so you can deploy and perf with confidence every time. The semi-disposable design integrates durable, reusable subs with single-use electrical and explosive components – to deliver a unique combination of reliable performance and efficient operation that you can't get from traditional, ported gun systems.



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Outstanding performance on every job.

All C&J perforating systems come equipped with added reliability. For example, our CCL-to-gun top sub and plug shoot sleeve are single-use only, which ensures that these vital components are in new, reliable condition for every run. And our #20 setting tool has a unique design that prevents the bleeder nut from coming loose and causing stuck tools.



You call the shots.

Let us know how you need your perforating system designed, and we'll make it happen.

Each C&J GameChanger perforating system is assembled to accommodate your specific perforation design with optimal reliability.

SPECIFICATIONS

Gun OD (in.)	3.125 (2.75 and 3.375 in development)
Gun Length (ft)	Up to 5
Shots per Foot	Up to 6
Temperature Rating of Addressable Switch	347°F
Pressure Rating (psi)	20,000
Charge Phasing	0, 60, 90 or 180°
Charge Types	Any standard drop-in charge

C&J ENERGY SERVICES

WE ARE C&J.

C&J Energy Services is a leading provider of well construction and intervention, well completion, well support and other complementary oilfield services and technologies. Operating across all active onshore basins of the continental U.S., we help oil and gas exploration and production companies maximize production and profitability for the entire life cycle of the well.



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CJES-18-108

EXHIBIT C



DESCRIPTION

The GameChanger perforating system features a semi-disposable gun assembly designed to increase efficiency and reliability by eliminating the misruns and resulting NPT associated with traditional gun systems. It is compatible with all manufacturers' standard shaped charges and uses addressable switches to provide real-time confirmation throughout the downhole descent. With no wires running between guns, the system provides design improvements that deliver a high level of confidence in the wellbore.

FEATURES AND BENEFITS

- Port-free design prevents getting stuck from a loose port plug, eliminates wiring pinch points and significantly decreases chances of gun flooding
- Spring-loaded connectors provide automatic, solid contact between guns and subs
- Addressable switches provide real-time confirmation throughout the downhole descent
- Lack of wires between guns and subs provides additional protection against pinched wires and failed connections
- Plug-and-play connections and easy arming remove pinch points that can cause firing failures
- Shorter subs reduce string length and weight, which provides safer on-site handling and greater efficiency
- Single-use components (CCL-to-gun sub and plug shoot sleeve) enhance reliability
- Compatibility with C&J #20 setting tool eliminates disengaged bleeder nuts

SPECIFICATIONS

Gun OD (in.)	2.75 and 3.125 (3.375 in development)
Gun Length (ft)	Up to 5
Shots per Foot	Up to 6
Temperature Rating of Addressable Switch	347°F
Pressure Rating (psi)	20,000
Charge Phasing	0, 60, 90 or 180°
Charge Types	Any standard drop-in charge